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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/677,006

09/30/2003

Wei Gao

SLA0805

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12/10/2004

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EXAMINER

MAGEE, THOMAS J

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 12/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/677,006

Applicant(s)

GAO ET AL.

Examiner

Thomas J. Magee

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |  |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)            |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>09302003</u> | 6) <input type="checkbox"/> Other: ____  |

## DETAILED ACTION

### *Claim Rejections – 35 U.S.C. 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C.102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1 – 3 are rejected under 35 U.S.C. 102(e) as being anticipated by Uchiyama (US 6,489,645 B1).

3. Regarding Claim 1, Uchiyama discloses a MOSFET (Col. 14, lines 51 – 54) gate structure comprising:

a gate dielectric (130) (Figure 1) overlying a substrate (135) (Col. 6, lines 20 – 21), and  
a niobium monoxide gate (120) (Col. 11, lines 54 – 57) overlying the gate dielectric (130).

4. Regarding Claim 2, Uchiyama does not disclose that the work function of the niobium monoxide is between approximately 4.1 and 4.4 eV. However, these values are well known for niobium monoxide and an intrinsic property of the material.

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5. Regarding Claim 3, Uchiyama discloses that the gate oxide (130) is silicon dioxide formed by thermal oxidation of the wafer (Col. 11, lines 38 – 41).

***Claim Rejections – 35 U.S.C. 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uchiyama, as applied to Claims 1 and 3, and further in view of Ma ("High-k Gate Dielectrics for Scaled CMOS Technology," Proc. 6<sup>th</sup> International Conf. On Solid State and IC Technology (October 22 – 25, 2001) pp. 297 – 302).

8. Regarding Claims 4 and 5, Uchiyama does not disclose the presence of a high-k dielectric material and composition of layer therewith. Ma discloses (p. 297, Abstract) the use of a number of high-k dielectric materials for gate dielectric layers, including HfO<sub>2</sub>, ZrO<sub>2</sub>, and Ta<sub>2</sub>O<sub>3</sub>. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a high-k material of Ma as a dielectric layer in Uchiyama to reduce excess tunneling.

9. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uchiyama, as applied to Claims 1 – 3, and further in view of Gonzalez et al. (US 6,468,852 B1).

10. Regarding Claims 6 and 7, Uchiyama does not disclose the presence or composition of a capping layer overlying the niobium oxide gate. Capping layers are used routinely in the art and Gonzalez et al. disclose the use of a silicon nitride layer atop the gate electrode (26) (Figure 1) (Col. 4, lines 63 – 67). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the capping layer of Gonzalez et al. in Uchiyama to provide a protective layer for the gate structure.

11. Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uchiyama, as applied to Claims 1 and 3, and further in view of Gonzalez et al. and Wilson et al. ("Handbook of Multilevel Metallization for Integrated Circuits," Noyes Publ., Westwood, N.J. (1993) p. 42).

12. Regarding Claims 8 and 9, Uchiyama does not disclose the presence of TiN capping layer as a conductive barrier layer atop the gate electrode. Gonzalez et al. disclose the use of a TiN capping layer (28) (Col. 4, lines 56 – 60) atop the gate electrode (24). Wilson et al. disclose that TiN is a conductive barrier material routinely used in the art (p.42, 1st para.). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Gonzalez et al. and Wilson et al. with Uchiyama to obtain a cap layer that improves conduction of the gate and serves as an effective diffusion barrier layer for motion of impurities into the gate structure.

13. Claims 10 and 11 are rejected under 35 U.S.C. 103 over Uchiyama in view of Ma.

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14. Regarding Claims 10 and 11, Uchiyama discloses a MOSFET gate structure comprising:  
a conductive metal monoxide (niobium oxide) layer (120) (Col. 11, lines 54 – 57) overlying the gate dielectric (130).

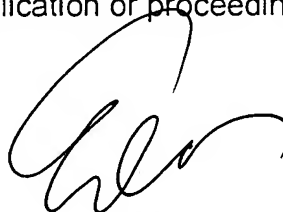
Uchiyama does not disclose the presence of a high-k dielectric material overlying the substrate. Ma discloses (p. 297, Abstract) the use of a number of high-k dielectric materials for gate dielectric layers. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a high-k material of Ma as a dielectric layer in Uchiyama to reduce excess tunneling.

Regarding the requirement of the metal monoxide (niobium oxide) having a work function between 4.1 and 4.4 eV, as discussed for Claim 2, this range of values is well known in the art and an intrinsic property of the material.

### **Conclusions**

15. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to **Thomas Magee**, whose telephone number is **(571) 272 1658**. The Examiner can normally be reached on Monday through Friday from 8:30AM to 5:00PM (EST). If attempts to reach the Examiner by telephone are unsuccessful, the examiner's supervisor, **Eddie Lee**, can be reached on **(571) 272-1732**. The fax number for the organization where this application or proceeding is assigned is **(703) 872-9306**.

Thomas Magee  
November 10, 2004



**EDDIE LEE**  
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